



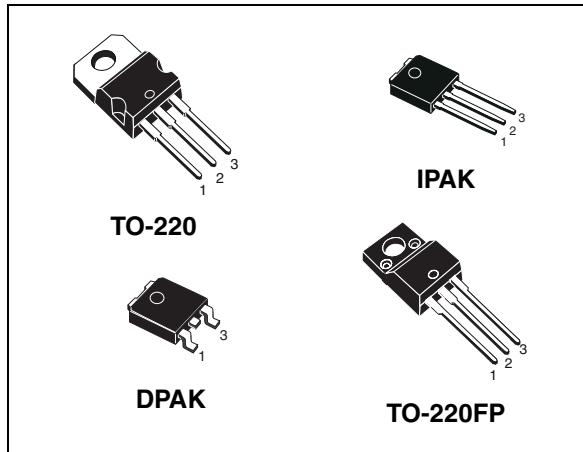
# STD7NM50N - STD7NM50N-1 STF7NM50N - STP7NM50N

N-channel 500V - 0.70Ω - 5A - TO-220 - TO-220FP - IPAK - DPAK  
Second generation MDmesh™ Power MOSFET

## Features

Type	$V_{DSS}$ (@ $T_{jmax}$ )	$R_{DS(on)}$	$I_D$
STD7NM50N	550V	<0.78Ω	5A
STD7NM50N-1	550V	<0.78Ω	5A
STF7NM50N	550V	<0.78Ω	5A <sup>(1)</sup>
STP7NM50N	550V	<0.78Ω	5A

1. Limited only by maximum temperature allowed
- 100% avalanche tested
  - Low input capacitance and gate charge
  - Low gate input resistance



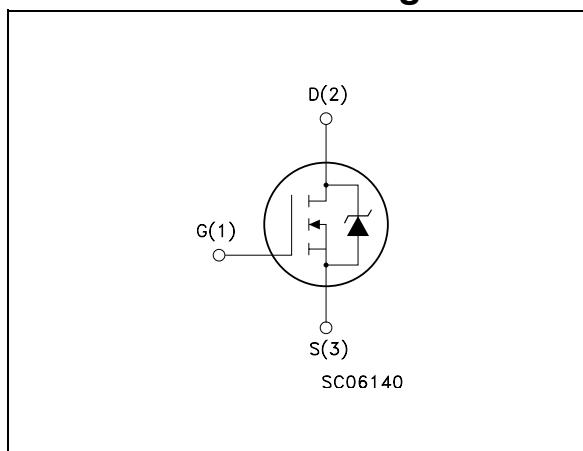
## Description

This device is realized with the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a new vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters

## Application

- Switching application

## Internal schematic diagram



## Order codes

Part number	Marking	Package	Packaging
STD7NM50N-1	D7NM50N	IPAK	Tube
STD7NM50N	D7NM50N	DPAK	Tape & reel
STF7NM50N	F7NM50N	TO-220FP	Tube
STP7NM50N	P7NM50N	TO-220	Tube

## Contents

<b>1</b>	<b>Electrical ratings</b>	<b>3</b>
<b>2</b>	<b>Electrical characteristics</b>	<b>4</b>
2.1	Electrical characteristics (curves)	6
<b>3</b>	<b>Test circuit</b>	<b>9</b>
<b>4</b>	<b>Package mechanical data</b>	<b>10</b>
<b>5</b>	<b>Packaging mechanical data</b>	<b>15</b>
<b>6</b>	<b>Revision history</b>	<b>16</b>

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220 / DPAK IPAK	TO-220FP	
$V_{DS}$	Drain-source voltage ( $V_{GS}=0$ )	500		V
$V_{GS}$	Gate-source voltage	$\pm 25$		V
$I_D$	Drain current (continuous) at $T_C = 25^\circ\text{C}$	5	5 <sup>(1)</sup>	A
$I_D$	Drain current (continuous) at $T_C = 100^\circ\text{C}$	3	3 <sup>(1)</sup>	A
$I_{DM}^{(2)}$	Drain current (pulsed)	20	20 <sup>(1)</sup>	A
$P_{TOT}$	Total dissipation at $T_C = 25^\circ\text{C}$	45	20	W
$dv/dt^{(3)}$	Peak diode recovery voltage slope	15		V/ns
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t=1\text{s}; T_C=25^\circ\text{C}$ )	--	2500	V
$T_j$ $T_{stg}$	Operating junction temperature Storage temperature	-55 to 150		°C

1. Limited only by maximum temperature allowed
2. Pulse width limited by safe operating area
3.  $I_{SD} \leq 5\text{A}$ ,  $di/dt \leq 400\text{A}/\mu\text{s}$ ,  $V_{DD} = 80\%$   $V_{(BR)DSS}$

**Table 2. Thermal data**

Symbol	Parameter	Max value		Unit
		TO-220 / DPAK IPAK	TO-220FP	
$R_{thj-case}$	Thermal resistance junction-case max	2.78	6.25	°C/W
$R_{thj-amb}$	Thermal resistance junction-amb max	62.5		°C/W
$T_l$	Maximum lead temperature for soldering purpose	300		°C

**Table 3. Avalanche characteristics**

Symbol	Parameter	Max value	Unit
$I_{AS}$	Avalanche current, repetitive or non-repetitive (pulse width limited by $T_j$ max)	2	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j=25^\circ\text{C}$ , $I_D=I_{AS}$ , $V_{DD}=50\text{V}$ )	100	mJ

## 2 Electrical characteristics

( $T_{CASE}=25^{\circ}\text{C}$  unless otherwise specified)

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{mA}$ , $V_{GS} = 0$	500			V
$dv/dt^{(1)}$	Drain-source voltage slope	$V_{DD} = 400\text{V}$ , $I_D = 5\text{A}$ , $V_{GS} = 10\text{V}$		40		V/ns
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max rating}$ , $V_{DS} = \text{Max rating}, T_c = 125^{\circ}\text{C}$			1 100	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{V}$			100	nA
$V_{GS(\text{th})}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\mu\text{A}$	2	3	4	V
$R_{DS(\text{on})}$	Static drain-source on resistance	$V_{GS} = 10\text{V}$ , $I_D = 2.5\text{A}$		0.70	0.78	$\Omega$

1. Characteristics value at turn off on inductive load

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15\text{V}$ , $I_D = 2.5\text{A}$		4		S
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 50\text{V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$		400 35 4		pF pF pF
$C_{oss\text{ eq.}}^{(2)}$	Equivalent output capacitance	$V_{GS} = 0\text{V}$ , $V_{DS} = 0\text{V}$ to $400\text{V}$		67		pF
$R_g$	Gate input resistance	$f=1\text{MHz}$ Gate DC Bias=0 Test signal level=20mV Open drain		6		$\Omega$
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 400\text{V}$ , $I_D = 5\text{A}$ $V_{GS} = 10\text{V}$ (see Figure 16)		12 2 6		nC nC nC

1. Pulsed: pulse duration =  $300\mu\text{s}$ , duty cycle 1.5%

2.  $C_{oss\text{ eq.}}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 250V, I_D = 2.5A,$ $R_G = 4.7\Omega, V_{GS} = 10V$ (see Figure 15)	7 5 40 9	ns ns ns ns	ns ns ns ns	ns ns ns ns
$t_r$	Rise time					
$t_{d(off)}$	Turn-off delay time					
$t_f$	Fall time					

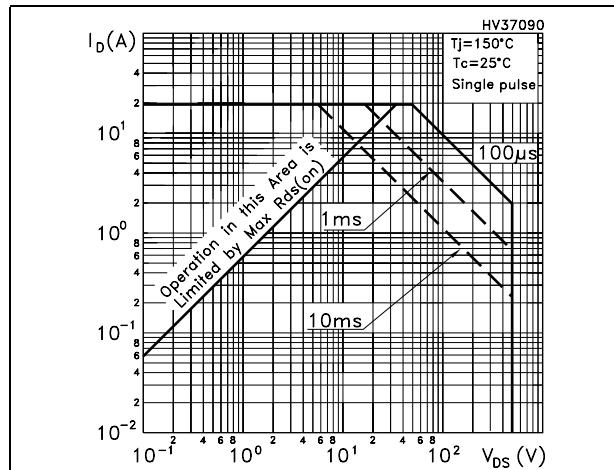
**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit				
$I_{SD}$	Source-drain current		5 20	A A	ns	A				
$I_{SDM}^{(1)}$	Source-drain current (pulsed)									
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 5A, V_{GS} = 0$	250 2 13	1.3	V	ns $\mu C$ A				
$t_{rr}$	Reverse recovery time	$I_{SD} = 5A, dI/dt = 100A/\mu s,$ $V_{DD} = 100V, T_j = 25^\circ C$ (see Figure 17)								
$Q_{rr}$	Reverse recovery charge									
$I_{RRM}$	Reverse recovery current									
$t_{rr}$	Reverse recovery time	$I_{SD} = 5A, dI/dt = 100A/\mu s,$ $V_{DD} = 100V, T_j = 150^\circ C$ (see Figure 17)	330 2 13	ns $\mu C$ A	ns $\mu C$ A	ns $\mu C$ A				
$Q_{rr}$	Reverse recovery charge									
$I_{RRM}$	Reverse recovery current									

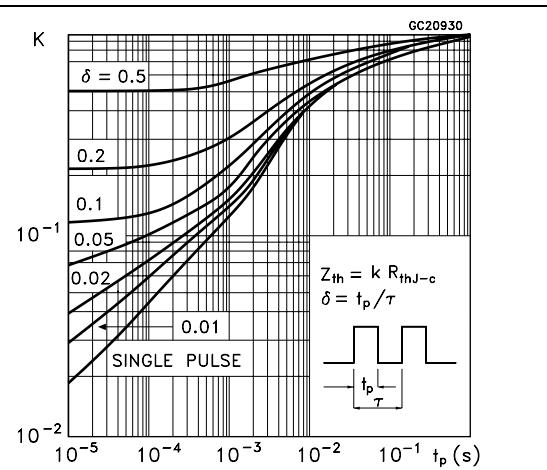
1. Pulse width limited by safe operating area
2. Pulsed: pulse duration = 300 $\mu s$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

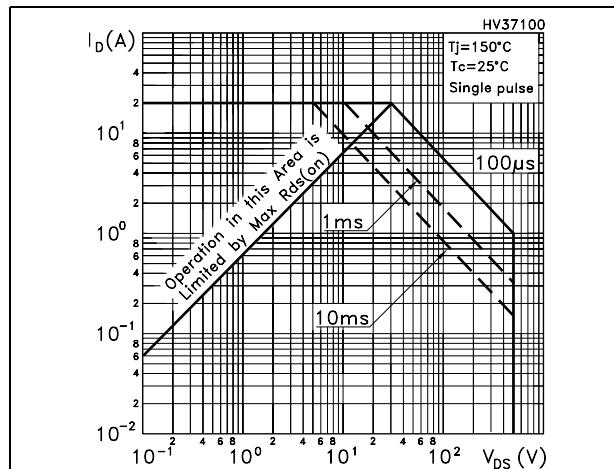
**Figure 1.** Safe operating area for TO-220 / DPAK / IPAK



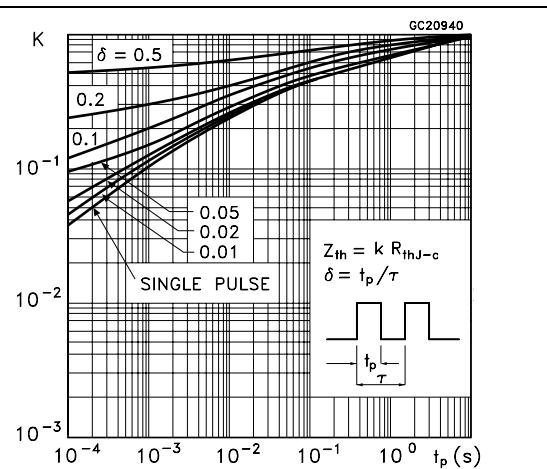
**Figure 2.** Thermal impedance for TO-220 / DPAK / IPAK



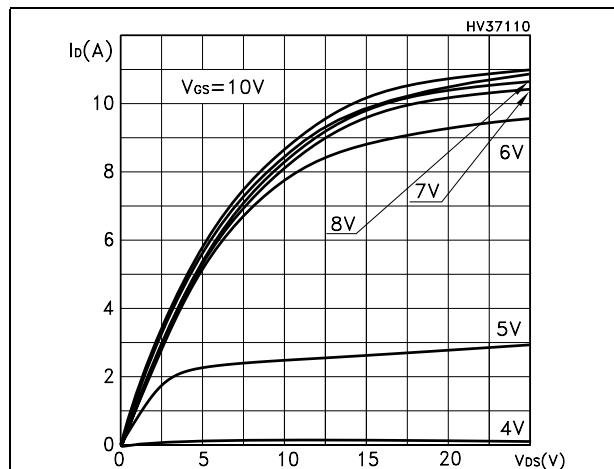
**Figure 3.** Safe operating area for TO-220FP



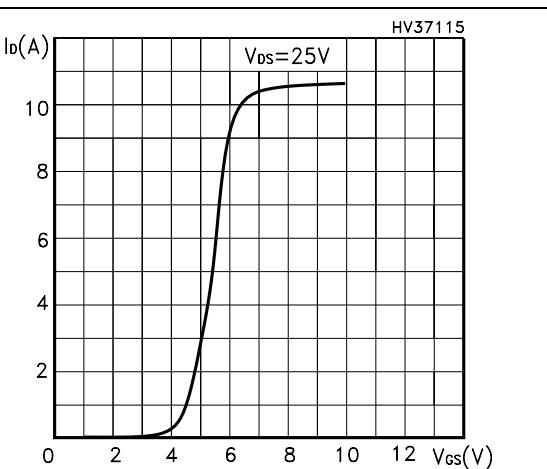
**Figure 4.** Thermal impedance for TO-220FP

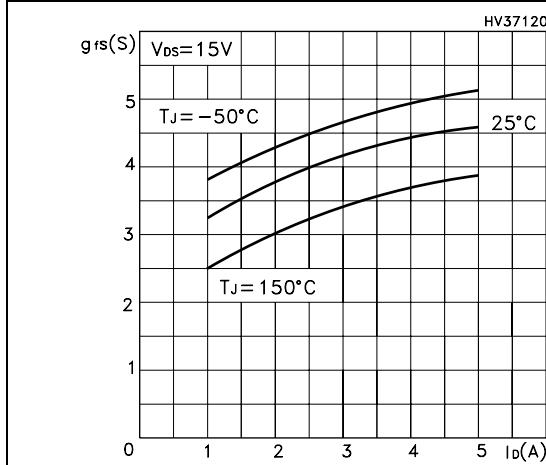
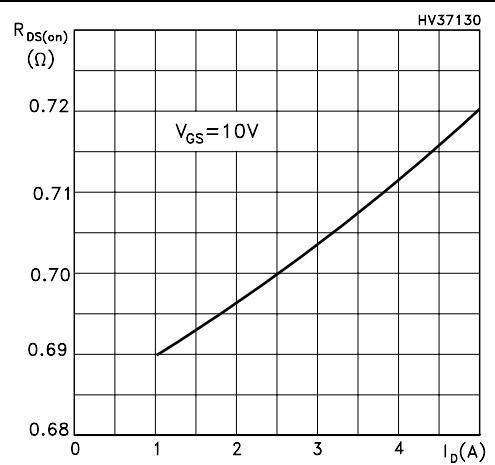
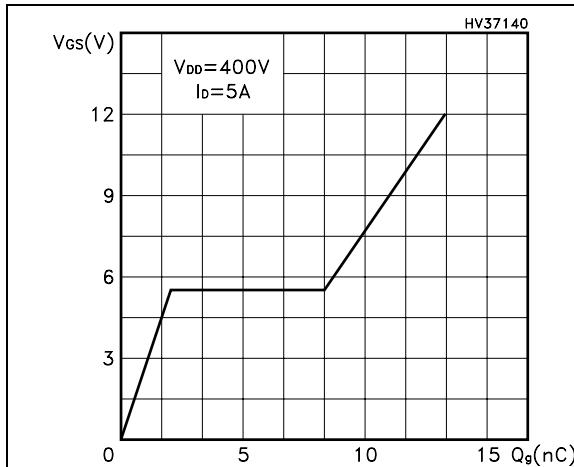
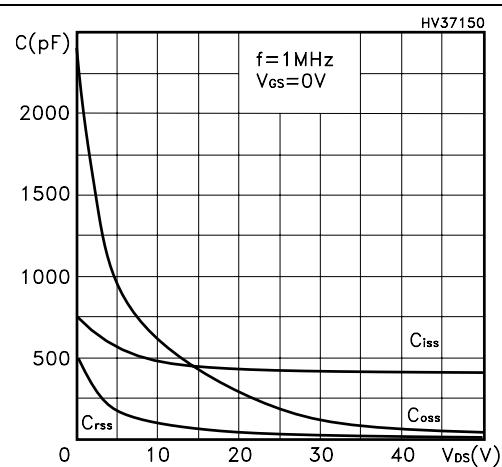
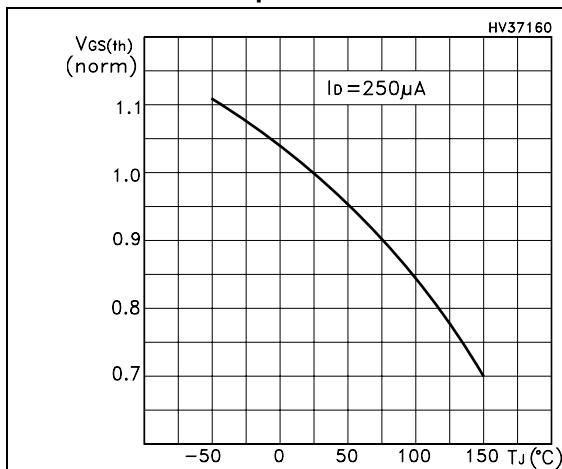
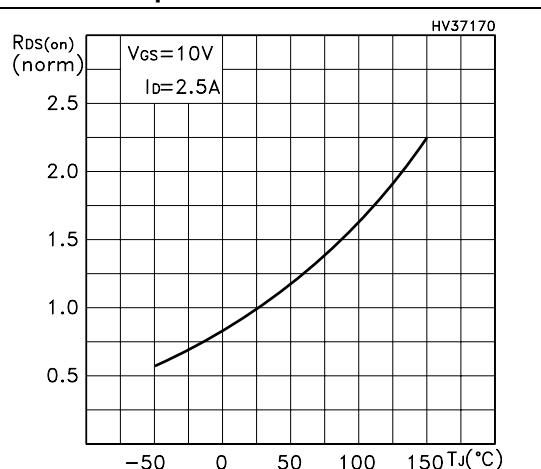


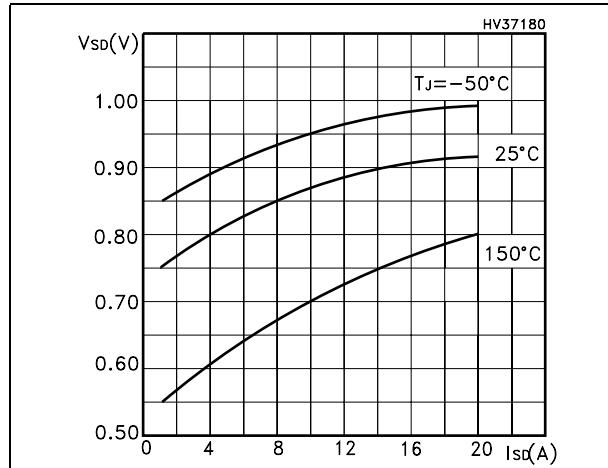
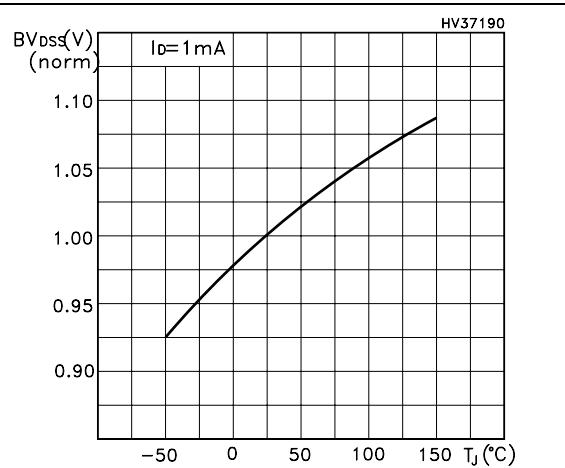
**Figure 5.** Output characteristics



**Figure 6.** Transfer characteristics

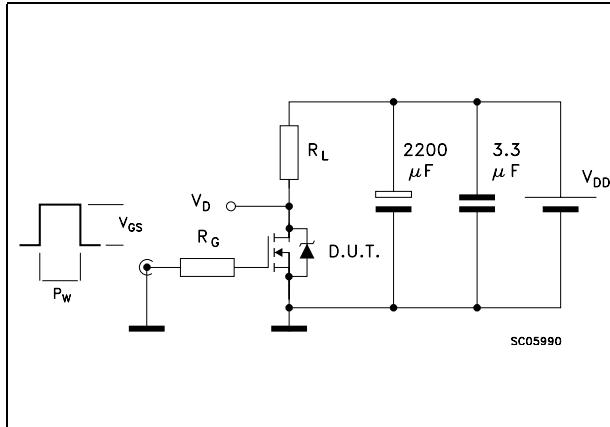


**Figure 7. Transconductance****Figure 8. Static drain-source on resistance****Figure 9. Gate charge vs. gate-source voltage****Figure 10. Capacitance variations****Figure 11. Normalized gate threshold voltage vs. temperature****Figure 12. Normalized on resistance vs. temperature**

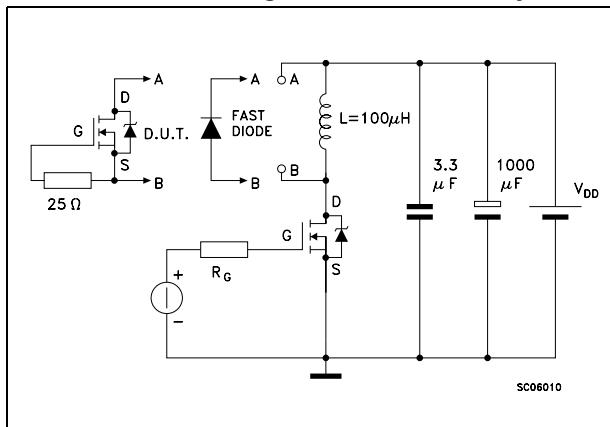
**Figure 13. Source-drain diode forward characteristics****Figure 14. Normalized  $BV_{DSS}$  vs. temperature**

### 3 Test circuit

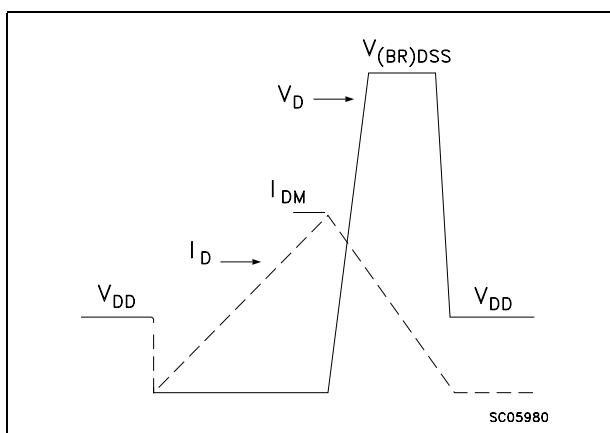
**Figure 15. Switching times test circuit for resistive load**



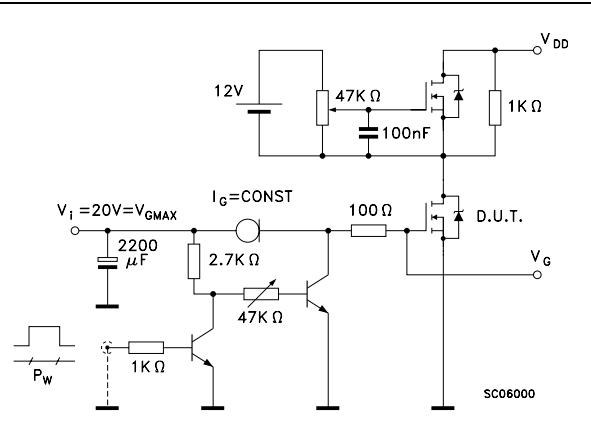
**Figure 17. Test circuit for inductive load switching and diode recovery times**



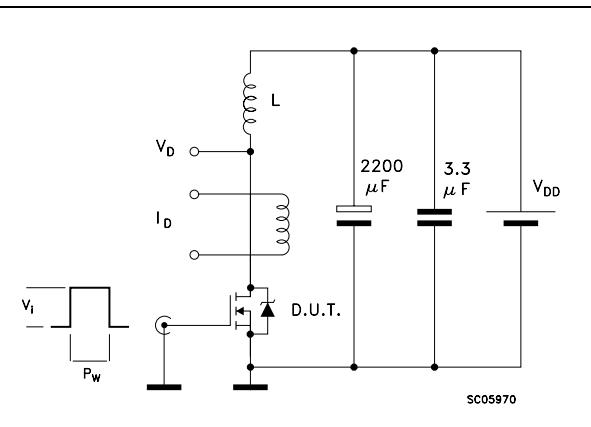
**Figure 19. Unclamped inductive waveform**



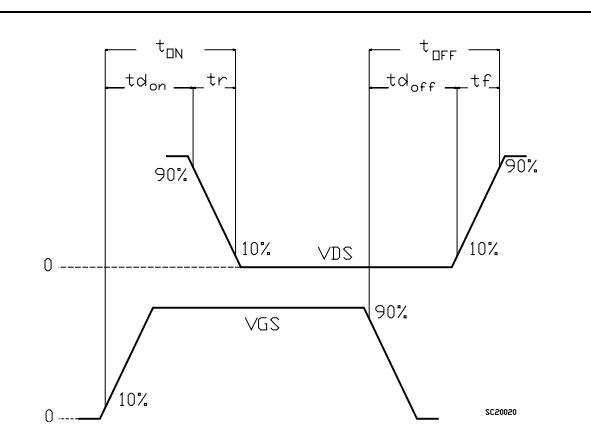
**Figure 16. Gate charge test circuit**



**Figure 18. Unclamped Inductive load test circuit**



**Figure 20. Switching time waveform**

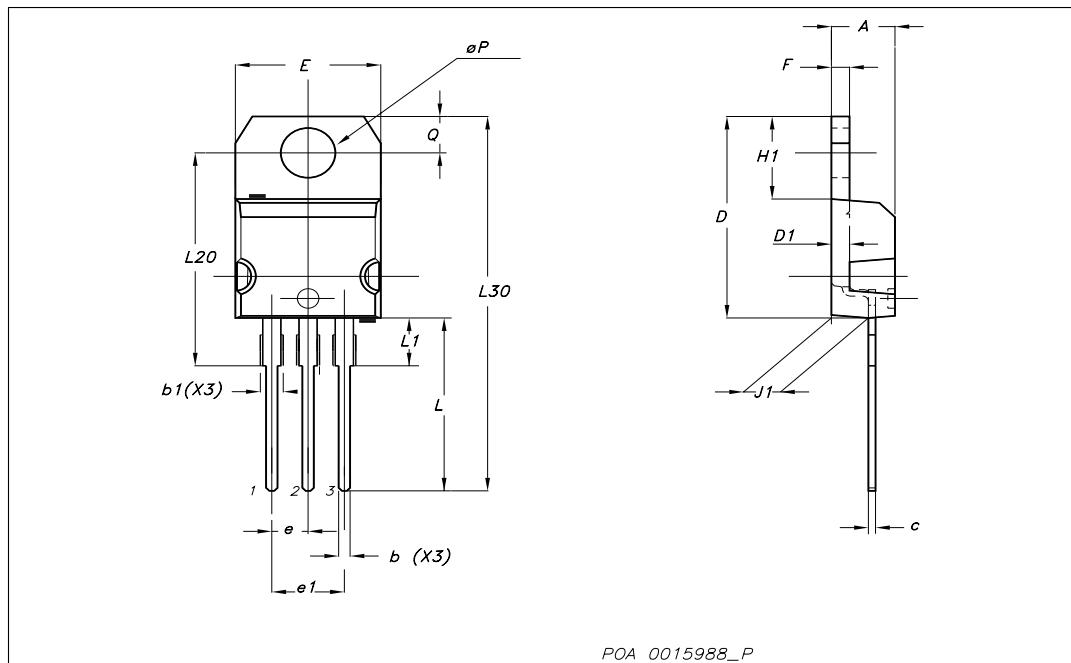


## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com)

## TO-220 mechanical data

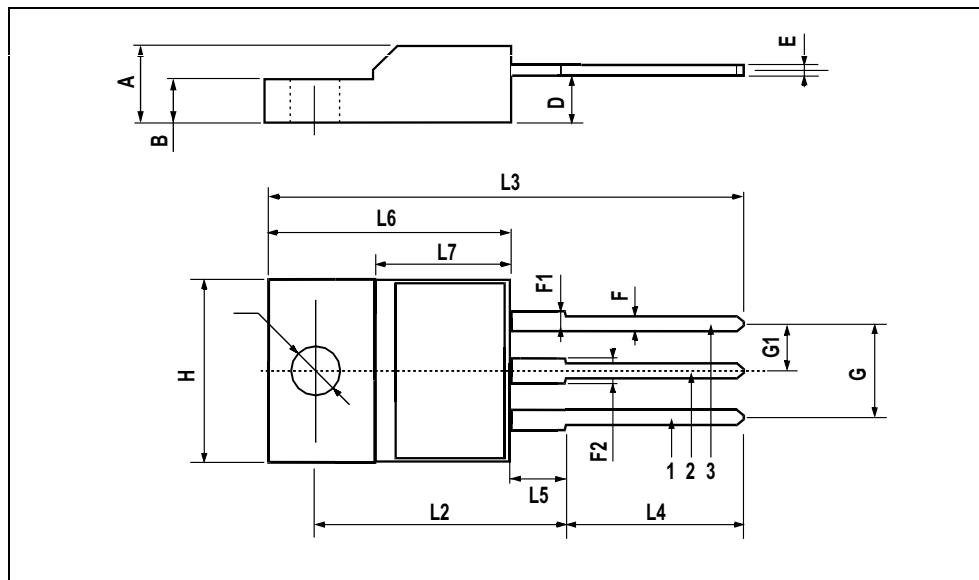
Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.6		0.62
D1		1.27			0.050	
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.051
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
ØP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



POA\_0015988\_P

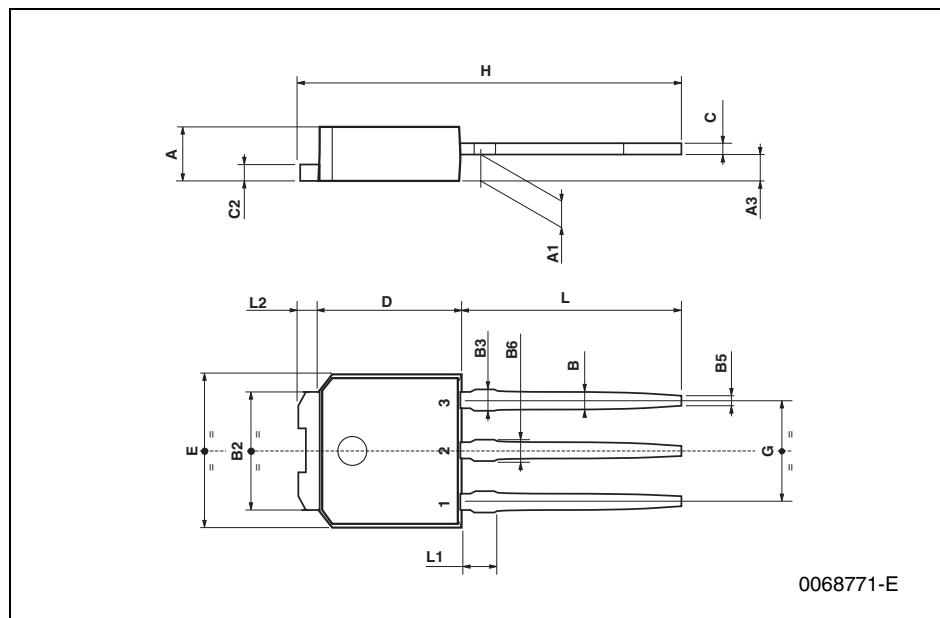
## TO-220FP MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
B	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.45		0.7	0.017		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.7	0.045		0.067
F2	1.15		1.7	0.045		0.067
G	4.95		5.2	0.195		0.204
G1	2.4		2.7	0.094		0.106
H	10		10.4	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	.0385		0.417
L5	2.9		3.6	0.114		0.141
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
Ø	3		3.2	0.118		0.126

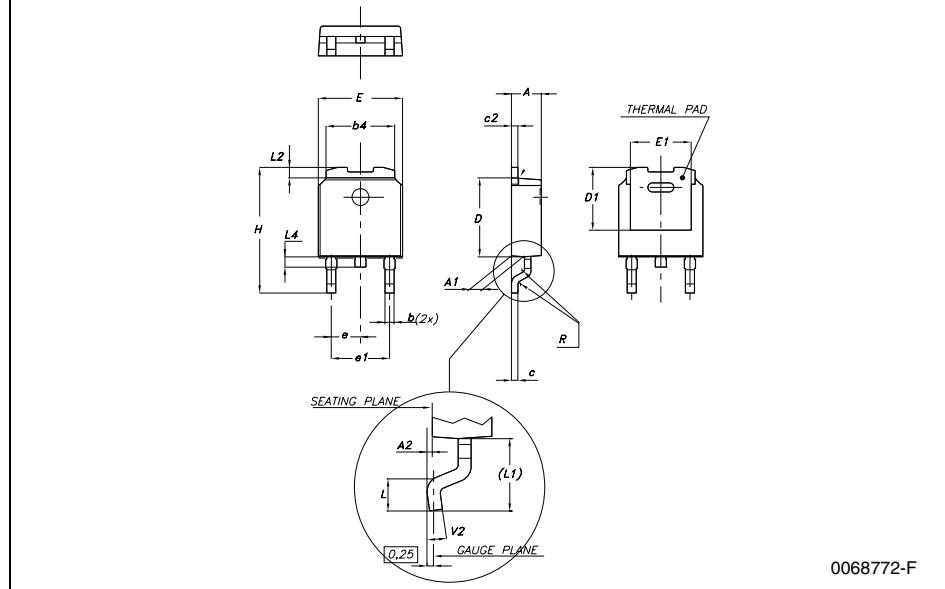


## TO-251 (IPAK) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A3	0.7		1.3	0.027		0.051
B	0.64		0.9	0.025		0.031
B2	5.2		5.4	0.204		0.212
B3			0.85			0.033
B5		0.3			0.012	
B6			0.95			0.037
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
E	6.4		6.6	0.252		0.260
G	4.4		4.6	0.173		0.181
H	15.9		16.3	0.626		0.641
L	9		9.4	0.354		0.370
L1	0.8		1.2	0.031		0.047
L2		0.8	1		0.031	0.039



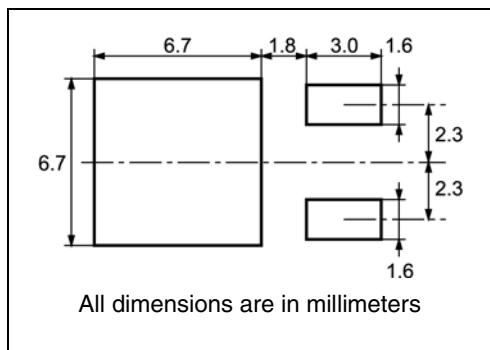
DPAK MECHANICAL DATA						
DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.9	0.025		0.035
b4	5.2		5.4	0.204		0.212
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
D1		5.1			0.200	
E	6.4		6.6	0.252		0.260
E1		4.7			0.185	
e		2.28			0.090	
e1	4.4		4.6	0.173		0.181
H	9.35		10.1	0.368		0.397
L	1			0.039		
(L1)		2.8			0.110	
L2		0.8			0.031	
L4	0.6		1	0.023		0.039
R		0.2			0.008	
V2	0°		8°	0°		8°



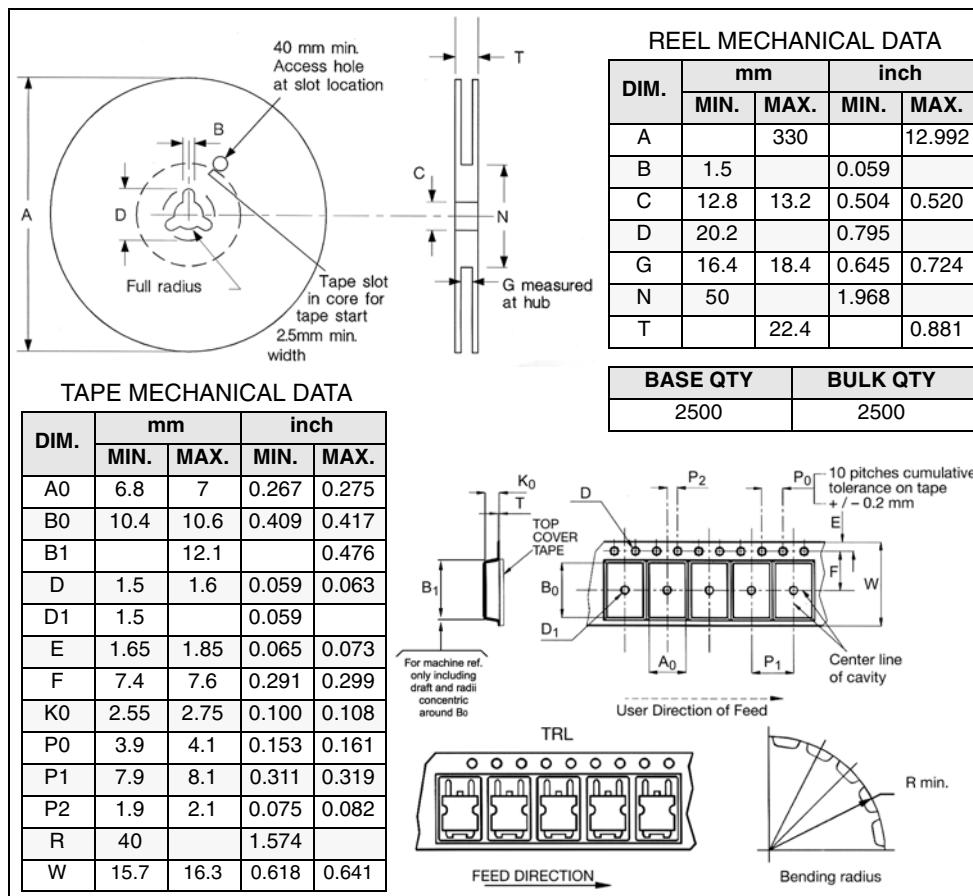
0068772-F

## 5 Packaging mechanical data

**DPAK FOOTPRINT**



### TAPE AND REEL SHIPMENT



## 6 Revision history

**Table 8. Revision history**

Date	Revision	Changes
10-Apr-2007	1	First release

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2007 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)

